OPI DATE 25/01/96 APPLN. ID 28087/95
AOJP DATE 14/03/96 PCT NUMBER PCT/NL95/00236

AU9528087

IDS
13

INT

(51) International Patent Classification 6 : F42D 1/22, G01V 1/104, E21B 23/01	A1	(11) International Publication Number: WO 96/01408 (43) International Publication Date: 18 January 1996 (18.01.96)

(21) International Application Number: PCT/NL95/00236

(22) International Filing Date: 4 July 1995 (04.07.95)

(30) Priority Data:
9401127 6 July 1994 (06.07.94) NL

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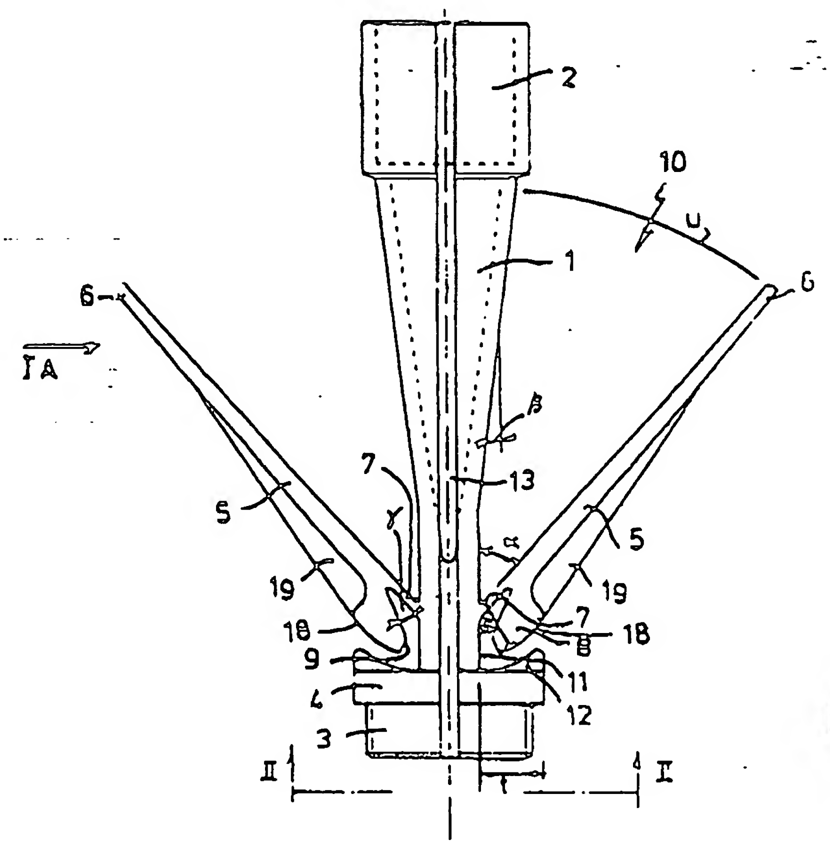
(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CA, CH, CN, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, ES, FI, FI (Utility model), GB, GE, HU, IS, JP, KE, KG, KP, KR, KZ, LK, LR, LT, LU, LV, MD, MG, MN, MW, MX, NO, NZ, PL, PT, RO RU, SD, SE, SG, SI, SK, SK (Utility model), TJ, TM, TT, UA, UG, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ, UG).

Published
With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.
In English translation (filed in Dutch).

(54) Title: SEISMIC ANCHOR

(57) Abstract

Seismic anchor (10) of plastic material, comprising a shaft (1) which is provided at the lower end (3) with an attaching means for an explosive charge (16) with detonator (15), wherein a plurality of arms (5) are integrally formed with the shaft (1), said arms (5) being connected to the shaft (1) by means of a flexible strip (7) and being provided with stop cams (8) to limit the slewing travel of the arms (5) relative to the shaft (1). The shaft (1) is furthermore provided with a passage slit (13) for detonating wires.



Seismic Anchor.

The invention relates to a seismic anchor, intended to prevent that explosive charges intended for seismic research, after insertion of the explosive charges into the soil, can be lifted by the detonating wires and could thus fall into the hands of unauthorized persons. The seismic anchor moreover prevents that the explosive charge can be pushed upwards through natural causes.

A known seismic anchor is manufactured from a synthetic material and comprises a shaft, provided at the upper end with an attaching means for a suspension means, by which the anchor can be introduced into a drill pipe or seismic borehole. At its lower end, the shaft is provided with a threaded connection means, onto which an explosive charge can be screwed. The known anchor is provided with a plurality of integrally formed arms or wings. These arms have a substantially constant, thin flat cross-section from their proximal end, where they merge into the shaft, up to their distal end, so that they are sufficiently flexible to be moved by the wall of the borehall towards the shaft during insertion of the anchor, so that the insertion of the anchor and the explosive charge is not hindered too much. Moulding the anchor, for instance by injection moulding, is done such, that the arms stand out obliquely upwards and outwards, wherein the distance between the distal ends of opposite arms will be such, that it is larger than the diameter of the borehole.

For the insertion of the anchor, cables are often used, in particular the detonating wires, which are attached with

their lower end to the anchor, wherein, if necessary, the anchor is weighed down with weights to overcome the friction of the anchor with the wall of the drill pipe or borehole. Alternatively, a push stick is used in order to be able to move the anchor and the explosive charge connected with it in a controlled fashion through the borehole or the drill pipe and past narrowings or indentations in the passage. The detonating wires are furthermore veered downwards adjacent to or through the push stick, until the anchor has arrived at the desired location. Subsequently, the optional push stick is removed and the anchor will remain behind, hanging from the detonating wires.

It has been found that the known anchor is not always able to prevent unauthorized persons from lifting the anchor by the detonating wires and thus to obtain the explosive charge and from using it for other purposes than the one originally intended.

Another known anchor, described in German patent 41 36 096, consists of a sleeve part and an anchor part, the sleeve part being provided with means for attaching an explosive cartridge and a spring-biassed locking lever and the anchor part being provided at the lower end with means for attaching a detonator and at the upper end with biassed anchor arms hingeably provided at the outer circumference. The anchor part can be inserted into the sleeve part against the biassing force, upon which the locking lever ensures that mutual axial displacement is prevented and that the anchor arms are kept in a folded up position by the sleeve part gripping around it. The known anchor can then be freely lowered into the drill pipe without the anchor arms being able to counter this movement by friction with the wall of the drill pipe. When the anchor has arrived at the lower end of the drill rod, the locking lever can fold outwards and the anchor part

can move upwards somewhat under the influence of the spring force so that the anchor arms can spread out to engage the wall of the borehole. At their lower end, near their hinge connection, the anchor arms are provided with stop cams, which, by abutting the upper edge of the sleeve part, prevent too great a swing of the anchor arms.

The object of the invention now is to provide a one-part seismic anchor of simple construction, which renders it practically impossible for unauthorized persons to retrieve the explosive charge. For this purpose, the invention provides a seismic anchor formed integrally of moulding material, comprising a shaft, suitable to be lowered into a borehole or drill pipe by means of a suspension means, such as a push rod, wherein the shaft has an upper end and is provided at a location below it with integrally formed freely sidewards projecting, relatively rigid arms or wings, which are movable between a first position, in which they at least almost abut the shaft and a second, spread-out position, inclined relative to the shaft, so as to be able to then engage the wall of a seismic borehole, wherein the shaft is furthermore provided with means for attaching an explosive charge, and the arms are connected to the shaft by means of an integrally formed flexible strip.

Since the arms in the anchor according to the invention are made relatively rigid, the deformation in the arm during movement between the first and the second position thereof will be restricted to an area located close to the shaft, but wherein deformation is prevented from concentrating in a line-shaped area (perpendicular to the shaft axis), which could thus cause that hinge portion to fail.

In order to prevent to a great extent, in a situation in which the anchor is inclined relative to the centre line

of the borehole, that the anchor with explosive charge can still be removed, the seismic anchor according to the invention preferably comprises stopping means to prevent the arms in the second position from further outward movement or rotation. This prevents that the (rigid) arms, during the exertion of an upward pulling force on the anchor, can swing over to a position in which they point downwards and can no longer function as barbs.

Preferably, on their side that is near the flexible strip and faces the lower end of the shaft, the arms are provided with integrally formed stops. The stop on the arm can therein be formed as a cam extending in proximal direction alongside the flexible strip, said cam thereby defining an interspace therewith. From a point of view of the moulding proces, it is advantageous if the flexible strip and the stop cam define a slot-like interspace tapering in distal direction.

In order to prevent that the interspace between the flexible strip and the cam can become clogged with soil particles, means are provided at the lower end of the shaft to screen that interspace, so that it is always assured that the arms can move from the first to the second, active position.

The stop formed on the arm preferably merges in distal direction into a stiffening rib for the arm. This stiffens both the arm and the cam.

It is furthermore preferred if the shaft is provided with a longitudinal slit for the reception of detonating wires, which is accessible from the side, and extends from the upper end to the lower end 1, so that these wires will not hinder the movement of the arms and can moreover not become easily damaged themselves.

The invention will now be explained by means of an examplary embodiment shown in the accompanying drawings. The following is shown in:

figure 1: a front view of an embodiment of the seismic anchor according to the invention;

figure 1A: a side view of the anchor of figure 1;

figure 2: a bottom view on the seismic anchor according to figure 1;

figure 2A: a cross-section along IIA-IIA in figure 1;

figure 3: the seismic anchor of figure 1 in the position, in which it is lowered into a borehole in the field; and

figure 4: the seismic anchor, shown in figure 3, but in this case when it has arrived at the correct height in the borehole.

Reference numeral 10 refers to the integrally formed seismic anchor (also called stop cap) according to the invention. The seismic anchor 10 comprises a shaft 1, which is substantially hollow and is provided at its upper end 2 with a receiving space which may or may not be threaded, for the lower end of a push stick (not shown here) and which is provided at its lower end with a cylindrical cross plate 4, below which a threaded, cylindrical attaching portion 3 is present. The shaft 1 tapers over a part in downward direction, with an angle ß of for instance 7°.

In the narrowest portion of the shaft 1, somewhat above the cross-plate 4, flexible strips 7 are formed integrally on the shaft 1, at locations located diametrically opposite each other, which flexible strips merge at their

distal end in integrally formed arms 5. The position of the arms 5 shown in figure 1 is that of the unloaded position, during moulding. The angle α is therein 40°.

The arms are provided at their distal end with rounded (see figure 2) engaging ends 6, which can engage the wall of the borehole when the anchor moves relatively upwards. The arms 5 are provided at the proximal end with integrally formed cams 8, which are provided with an inwardly turned stop surface 9. At their distal end, the cams 8 smoothly merge into stiffening rib 19, which gradually decreases in height in distal direction. This provides stiffnes for both the cam 8 and the arm 5. Between the cam 8 and the flexible strip 7, a slit-like interspace tapering in distal direction is formed, wherein the taper γ is 18°. When the angle α is increased, so when the arms 5 are rotated further, the deformation of the flexible strip 7 is not hindered by the cam 8.

An advantage of the narrowing of the shaft 1 at the location of the connection of the arms 5 is that when the anchor is lowered into a drill pipe, the cams will, in the more or less folded position of the arms, remain substantially within the profile defined by the cross-plate 4 and will not form an obstacle which would hinder, in engagement with the wall of a drill pipe, in particular the transitions between the constituting parts thereof, the lowering of the anchor. The same applies for the further, more distal portion of the arms, which can be designed thicker without forming an obstacle. The cams are moreover rounded at their outer side to further benefit the lowering proces.

The cams 8 can therein be located with their outer side at a distance s of the connection of the flexible strip 7 with the shaft 1, which approximates the size t of the narrowing.

Figure 2 shows in the bottom view of the anchor 10 that a radially directed groove 13 extends in the shaft 1, which groove runs entirely from top to bottom. In this groove 13 the detonating wires can be placed, so that they will not be in the way and at the same time cannot become damaged themselves.

The seismic anchor 10 is furthermore provided with elevations 12 formed on the cross-plate 4, which elevations gradually slope in circumferential direction and run concavely downwards in radial direction. These elevations 12 prevent that soil, especially grains of sand, get in the interspace between cam 8 and flexible strip 7 and the shaft, where they could then render the outward swing of the arms 5 impossible. In application in layers of soil with a coarser grain material, especially fine gravel (in Dutch: kif), the elevations can be omitted because a grain could then become stuck between the elevation and the cam. The projections 12 can moreover have a function in providing a bearing for the lower side of the cams 8 in the case of a far-reaching deformation of the flexible strips 7 and similar rotation of the arms 5. For this purpose, the cams 8 are provided with downwardly directed contact faces 18. The cams 8 herein therefore have a two-fold stopping function.

In figure 3, the anchor 10 is connected with its upper end 2 to the projecting lower end 31 of a push rod 30 in a manner suitable for absorbing downward forces. At the lower end of the anchor 10, the cylindrical attaching portion 3 is attached via a threaded connection to the upper portion 17 of a sleeve 14, in which furthermore detonator 15 and explosive 16 are incorporated.

By means of for instance the push rod 30, the anchor 10 with the explosive charge attached thereto, said explosive charge being received in the sleeve 14, is moved downward

in the borehole 21 in the ground 20, by exertion of a Force F_1. Alternatively, the anchor can be lowered hanging from the detonating wires, wherein a series of swelling sleeves stacked on top of the anchor provide the requisite force that urges the anchor downward. The (subaqueous) weight of the swelling sleeves is herein smaller than the failure force of the detonating wires. The swelling sleeves can hereafter perform their closing-off function. can a swelling sleeve be used for the downward movement. This is rendered possible, among other things, by the length of the arms 5 relative to the distance from the strips 7 to the upper end 2 being chosen such, that the arms during a folding movement (figure 1, track u) remain with their ends 6 below the upper end 2, at least below the upper edge of that upper end, which can then serve as support surface for the swelling sleeve. The wall of the borehole 23 exerts a radially inward force on the engaging ends 6 of the arms 5 so that these, hinging about the flexible strips 7, are moved in a direction towards the shaft 1. When the assembly of anchor 10 and sleeve 14 has reached the correct height in the borehole 21, then the push stick 30 is lifted, so that the end 31 exits the cavity 2, and is pulled out of the borehole. The detonating wires 32a, 32b, (figure 4) remain behind and extend upwards from the detonator 15, through the slit 13, towards ground level. By exertion of the force F_2 on the wires 32a, 32b, the engaging ends 6 of the arms 5 will penetrate the wall of the borehole 23, so that the position shown in figure 4 is realized. The cam 8 then engages with the abutting surface 9 against abutting surface 11 of the shaft 11, so that a further twisting of the arms is substantially prevented. As a consequence of the large distance (order of magnitude of s), rendered possible by the narrowing, from the abutting surface 9 of the cam 8 to the connection of the strip 7 with the shaft 1, a significant moment can be absorbed when the abutting surface 9 abuts against the shaft, by which the stability

of the arm against swinging over is increased. Any axial displacement of the arm 5 relative to the shaft 1, rendered possible by the flexible hinge strips 7, is limited by abutment of the cam surfaces 18 on the projections 12 on the cross-plate 4. Consequently, it is completely prevented that the arms 5 can swing through, while the arms 5, so due to the stiffening rib 19, are themselves strong enough not to be bent to an inadmissible extent.

According to standards, both detonating wires may have a joint maximum tensile strength of 200 Newton. This means that, in order to prevent an unauthorized person from being able to lift both the anchor and the explosive charge by pulling the detonating wires, the opposing force to be supplied by the anchor should minimally be 200 Newton. Tests have shown that this requirement can easily be met by the anchor according to the invention.

By way of example, a number of dimensions and other properties of the anchor according to the invention will be given below. The anchor is made integrally by injection moulding from placic, preferably HMPE, but PP and PA are also possible, while starch plastic can also be used. In the unloaded position, the distance between both engaging ends 6 is 130 mm. In the position shown in figure 3, this distance has been reduced to 70 mm, while in the position shown in figure 4, this distance has been increased to 180 mm. The diameter of the cross-plate 4 is 30 mm. When the arms abut the shaft, the anchor can be lowered in a drill pipe with a cross-section of 40 mm. The length of the anchor is therein 138 mm, while the smallest and greatest thickness of the shaft at the location of the cross-section of figure 2A is 9 mm and 23 mm, respectively. The lenght of the arms 5 is 100 mm (including the cam), while the thickness of the flexible strip 7 is 1.5 mm, the width 20 mm and the length is 7 mm. The width of the arms is 20

mm, while the radius of the rounding of the engaging ends 6 can be 25 mm. With this anchor, it turned out to be possible to resist a force of over 250 Newton. Moreover, it has even been found that when the borehole was wider than 100 mm, lifting was checked because one of the wings would touch the borewall during lifting, would enter this wall and would be capable of withstanding a tensile force of 250 Newton.

CLAIMS

1. Seismic anchor formed integrally of moulding material, comprising a shaft, suitable to be lowered into a borehole or drill pipe by means of a suspension means, such as a push rod, wherein the shaft has an upper end and is provided at a location below it with integrally formed freely sidewards projecting, relatively rigid arms or wings, which are movable between a first position, in which they at least almost abut the shaft and a second, spread-out position, inclined relative to the shaft, so as to be able to then engage the wall of a seismic borehole, wherein the shaft is furthermore provided with means for attaching an explosive charge with detonator, and the arms are connected to the shaft by means of an integrally formed flexible strip.

2. Seismic anchor according to claim 1, further comprising stopping means to prevent the arms in the second position from further outward movement.

3. Seismic anchor according to claim 2, wherein the arms are provided on their side that is near the flexible strip and faces the lower end of the shaft, with an integrally formed stop.

4. Seismic anchor according to claim 3, wherein the stop has the shape of a cam extending in proximal direction alongside the flexible strip, said cam thereby defining an interspace therewith.

5. Seismic anchor according to claim 4, wherein the interspace is a slot-like space tapering in distal direction.

6. Seismic anchor according to claim 4 or 5, wherein the shaft is provided at its lower end with means for screening the interspace.

7. Seismic anchor according to any one of the claims 3-6, wherein the stop formed on the arm merges in distal direction into a stiffening rib for the arm.

8. Seismic anchor according to any one of the claims 3-7, wherein the shaft has a lower end, which is widened relative to the narrow portion of the shaft located above it, and the flexible strips are connected to the narrow shaft portion.

9. Seismic anchor according to claim 8, wherein the distance between the stop cam and the connection of the flexible strip to the narrow shaft portion is in the order of the, considered on one side, narrowing which forms the narrow portion relative to the widened lower end, and is preferably somewhat smaller.

10. Seismic anchor according to any one of the preceding claims, wherein the length of the arms, related to the shaft, is such that they can completely abut the shaft and are then situated with their outer ends below the upper end thereof.

11. Seismic anchor according to claim 10, wherein the upper end forms a support means for swelling sleeves.

12. Seismic anchor according to any of the preceding claims, wherein the shaft is provided at its lower end with a threaded connection for attachment thereon of an

explosive charge with detonator.

13. Seismic anchor according to any one of the preceding claims, wherein the shaft is provided with a longitudinal slit, which is accessible from the side, and extends from the upper end to the lower end for the reception of detonating wires.

14. Seismic anchor according to any one of the preceding claims, formed by synthetic material such as HMPE, PP, PA or of starch plastic.

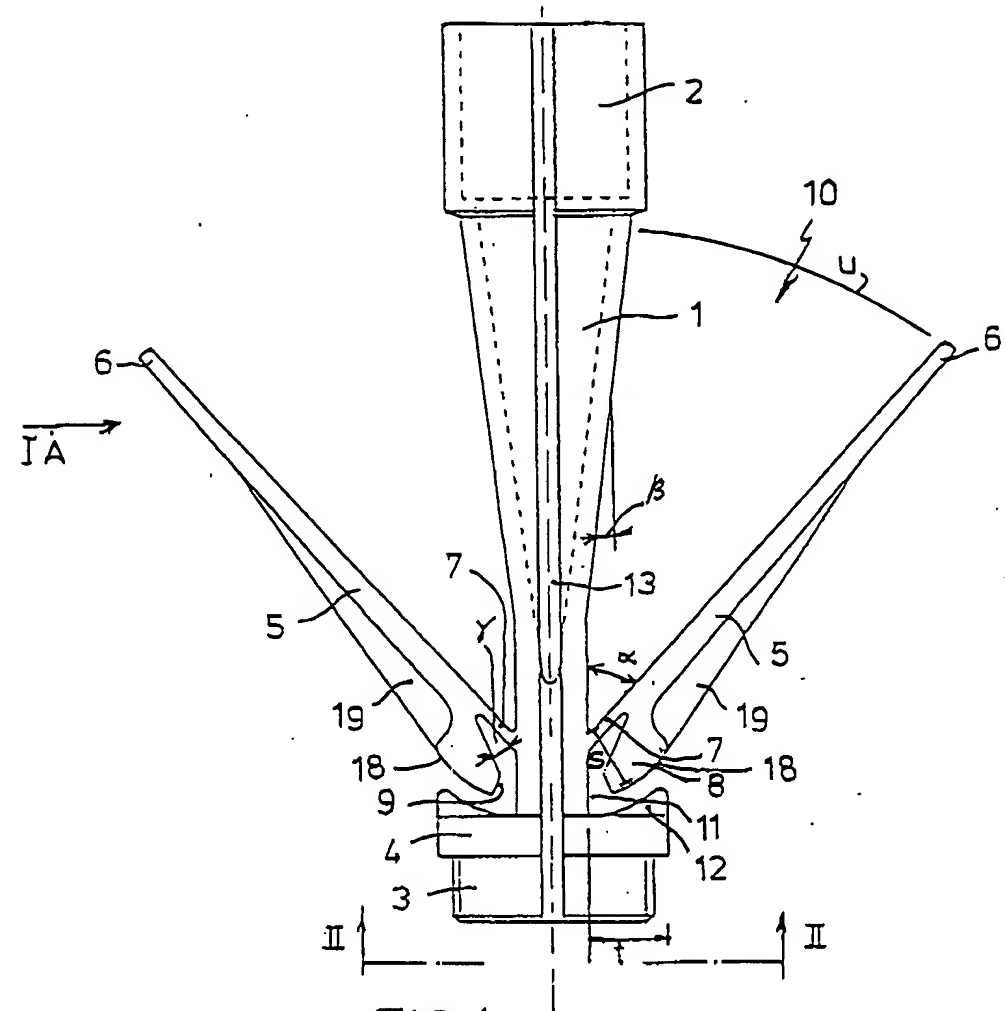


FIG.1

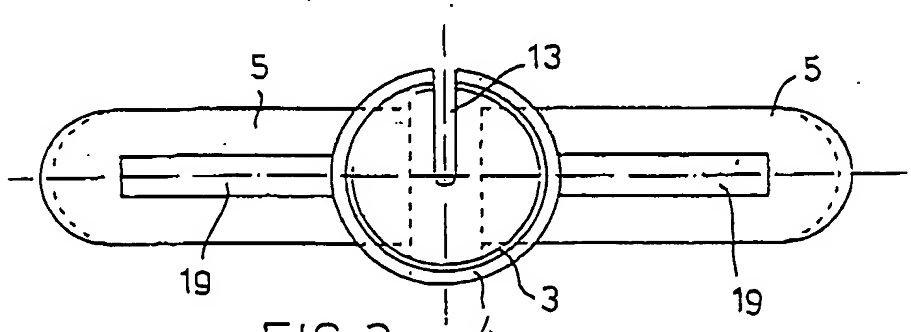


FIG. 2

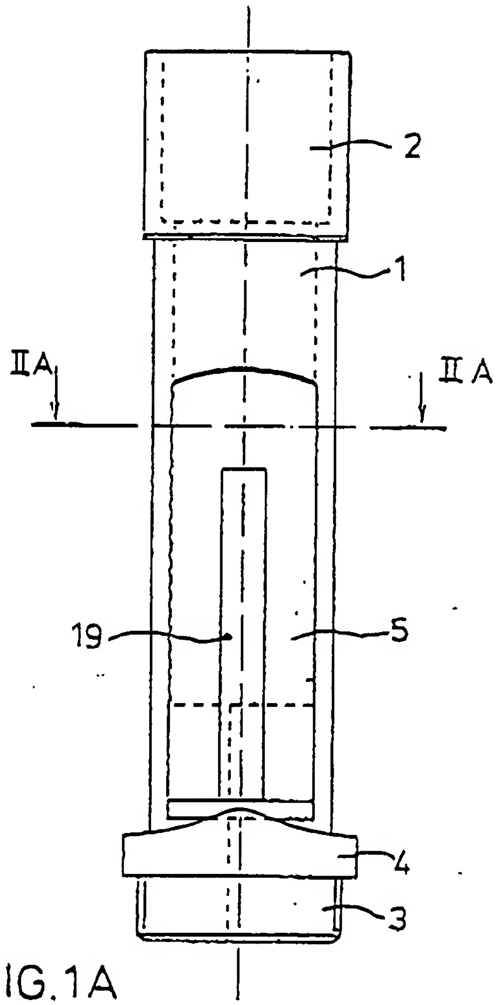


FIG.1A

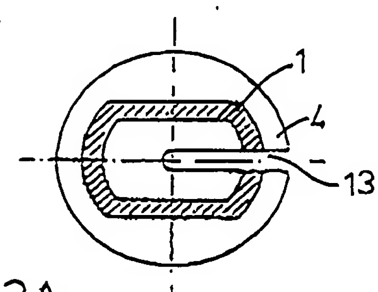


FIG.2A

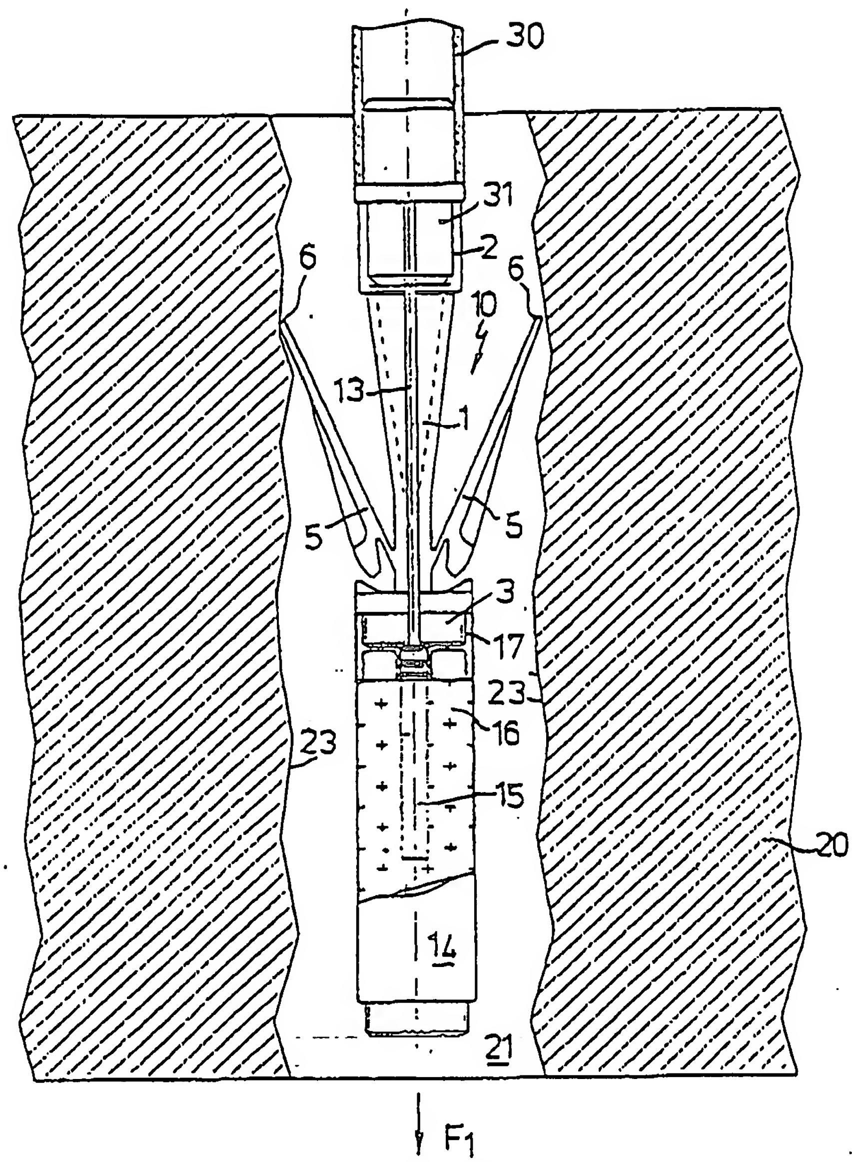


FIG. 3

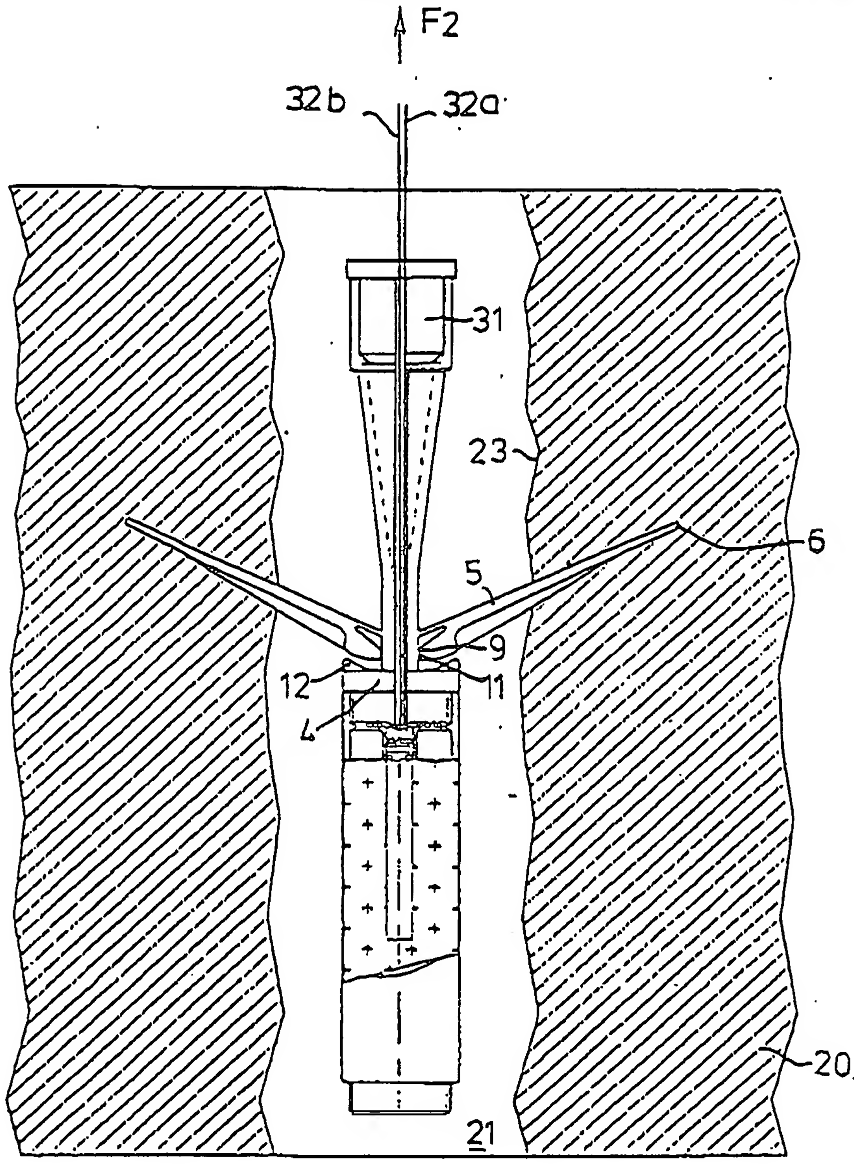


FIG. 4

INTERNATIONAL SEARCH REPORT

Int. ...onal Application No
PCT/NL 95/00236

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 F42D1/22 G01V1/104 E21B23/01

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 F42D E21B G01V

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
P,X	US,A,5 343 002 (GREMILLION) 30 August 1994 see column 3, line 3 - line 23; figures 2,5 ---	1
X	DE,C,41 36 096 (EDWIN DEUTGEN KUNSTSTOFFTECHNIK GMBH) 17 December 1992 see column 3, line 33 - column 5, line 29; figure 3 ---	1
A	EP,A,0 564 773 (DITOM KUNSTSTOFFENTWICKLUNGS- UND VERTRIEBSGESELLSCHAFT MBH) 13 October 1993 see column 3, line 41 - column 5, line 56; claim 5; figures 1-8 ---	2,3
A	GB,A,810 528 (HAYDEN-NILOS LTD.) 18 March 1959 see the whole document --- -/--	3-6,8-11

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 October 1995	13. 11. 95

Name and mailing address of the ISA	Authorized officer
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INTERNATIONAL SEARCH REPORT

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C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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FR-A-1535002		GB-A-	1187661	15-04-70